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HAZARDOUS
SITE CONTROL
DIVISION

Remedial Planning/ Field Investigation Team (REM/FIT)

ZONE II

CONTRACT NO.
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CH2M HILL
Ecology &
Environment

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SOIL SAMPLE RESULTS FOR CHEMICAL CONTAMINATION BELOW SAUGET/SAUGET LANDFILL IN SAUGET, ILLINOIS

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INTRODUCTION

Problem

In the spring of 1980, workers unearthed buried drums and noxious odors while constructing a railway spur across a former municipal landfill called Sauget/Sauget Landfill (S/SL) in Sauget, Illinois. Since noxious odors and labels on the uncovered drums indicated that the substances might be toxic, environmental officials at both the state and federal levels were notified. It was determined that further investigation should be conducted to determine just how serious a problem actually existed. At this point, Ecology and Environment, Inc.'s (E&E) Field Investigative Team (FIT) was assigned the responsibility of assessing and performing any work that would define the level of contamination emanating from past disposal at S/SL.

Purpose

The objective of FIT work at S/SL was to safely and accurately perform a drilling and sampling program of soils below the landfill for the determination of chemical contamination. This included the use of remote sensing techniques to first locate areas where buried drums might exist.

History

The portion of S/SL, which this investigation is concerned with, operated from 1959 (its beginning) to approximately 1966, Figure 1. During this period, Paul Sauget of Sauget and Company (a Delaware corporation) operated it as a municipal landfill. Simultaneously and directly adjacent to S/SL he operated the W. G. Kummerich, Sauget/Toxic Landfill. Sauget/Toxic Landfill was used for disposal of processing waste from Monsanto Company of Sauget, Illinois.

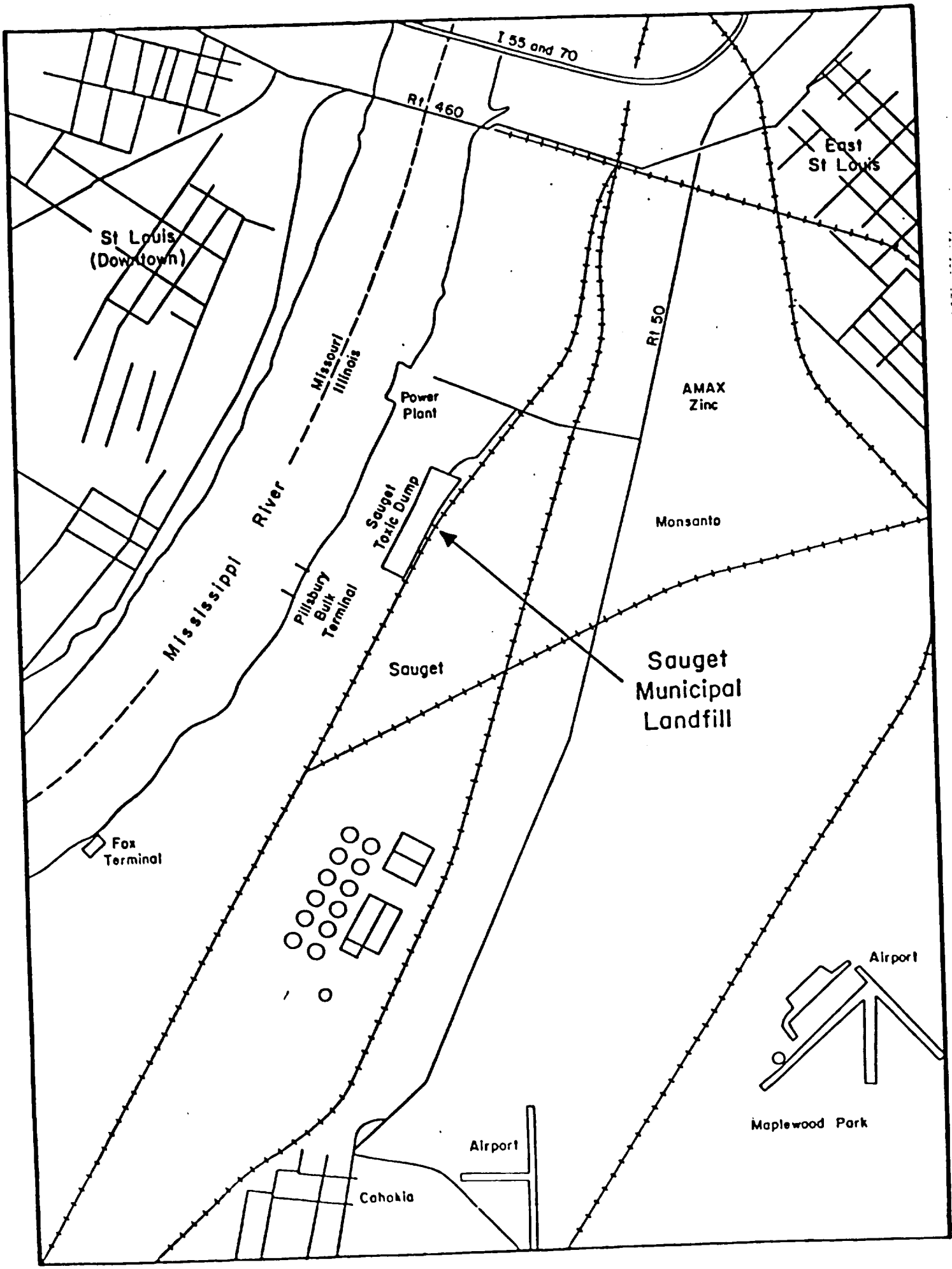

FIGURE 1. General Site Map

Site inspection reports from health officials during this period indicated about a lack of daily cover, open burning, and disposal of drumed waste at S/SL. Reportedly, the landfill, during operation and since, has been inundated many times by flood waters of the Mississippi River. The flood height on-site has been enhanced by the flood control levee which borders S/SL on the east side.

Since S/SL ceased operation, approximately four to five feet of fly ash cinders has been spread over the landfill as cover. These cinders are coarse grain in nature and therefore unsuitable as cover material.

Method of Study and Field Work

The objective of the study was to obtain soil samples below the landfill for chemical analyses. Therefore, to insure the safety of drilling and sampling personnel, it was necessary to identify portions of the landfill that might contain buried drums. Remote sensing techniques (magnetometer, ground penetrating radar (GPR), electromagnetic conductivity (EMC), etc.) were decided to be the only feasible methods. Remote sensing on the landfill would also present its own unique problems. The landfill has three sets of high voltage power lines, two railroad lines, and portions of a chain-link fence which would all affect the readings from the delicate instrumentation. It was concluded that a specialist with instrumentation and interpretation skills sophisticated enough to overcome these obstacles be subcontracted.

The subcontractor chosen was TECHNOS, Inc. of Miami, Florida. Besides having the lowest bid, TECHNOS was also the only contractor to offer the use of a continuous output gradiometer magnetometer (see Appendix 2).

Assisted by E&E's personnel, TECHNOS performed all on-site work in modified level C safety, utilizing air powered purifying respirators to protect against inhalation of contaminated particulate matter.

The TECHNOS approach included two phases. In Phase I, three techniques, GPR, EMC, and magnetics, were evaluated on-site to determine the best method for locating drums. Phase II was conducted using a gradiometer magnetometer (which proved to be the best of the three geophysical methods tested in Phase I) along 33 parallel traverse lines spaced at 12.5 foot intervals across the site with readings every 12.5 feet thus, forming a grid and providing approximate total site coverage. A drawing of the site (to scale) with grid and gradiometer magnetometer results superimposed on it appear in TECHNOS Figure 7 (included in back plate pocket). The following significant information was derived from this survey:

1. Magnetic anomalies (intensity level 1, TECHNOS Figure 7) were recorded over most of the landfill which probably indicate the limits of landfilling.

2. Magnetic anomalies with greater intensity (levels 2 and 3, TECHNOS Figure 7) were located in several areas in the north-central and western portions of the site. These areas are delineated in TECHNOS Figure 7 and indicate burial areas of relatively large concentrations of steel/iron materials such as drums or car bodies.

3. The delineated magnetic variations may be caused by drum-like masses occurring at depths of 2 to 25 feet. If drums, these individual masses could represent 1 drum at a depth of 2 feet to as many as 50 drums to depths as 25 feet (over a surface of about 25 feet in diameter).

The information provided in the TECHNOS report allowed FIT to develop a drilling/sampling program on the grid while performing it in the safest manner possible. Every attempt to place borings equidistant to one another on the grid was made. However, the location of buried drums and an area of large cinder piles north of the 500 grid line prevented this. Borings here were placed in the only locations possible. Borings south of the 900 grid line were located on an equidistant pattern. The sampling program consisted of drilling 18 holes through the landfill in order to take 35 soil samples below it. Two split spoon samples of soil at different depths were taken below the bottom of the landfill and above the top of the water table with the exception of B16. The first soils encountered below the landfill in B16 were also found to be below the water table; therefore, the second soil sample was not collected.

Prior to any drilling at S/SL, all drilling equipment including tools and rig were steam cleaned under the supervision of E&E's personnel. Between borings, all tools, augers, racks, split spoons etc., were steam cleaned to prevent cross contamination. Between samples in each boring the split spoons were decontaminated by first washing them with tap water, secondly rinsing with acetone, and finally rinsing with distilled water.

All drilling and soil sampling at S/SL were done in modified level A safety. This entailed wearing Tyvec moon suits with clear bubble head gear and attached "life line" air lines.

Previous Studies

To date, the only site specific study of S/SL has been a thermal infrared survey done by Environmental Monitoring Systems Laboratory (Shelton, aerial 1982). The W. G. Krummrich AKA Sauget Toxic Landfill which borders Sauget/Sauget Landfill on the west side has been the subject of numerous studies including a hydrogeologic study by D'Appolonia.

Acknowledgements

Thanks are extended to Riverport Terminal and Fleeting Company and the Pilsbury Company for their cooperation in granting access to property. Thanks are also extended to TECHNOS, Inc. and Canonnie Construction for their effort in the field under high level safety conditions.

SITE DESCRIPTION

Location and Physiography

Sauget/Sauget Landfill is located in the town of Sauget in St. Clair County, Illinois. It is approximately 200 yards from the Mississippi River and lies on the flood plain known as the American Bottoms.

The area covered by this report is that portion of S/SL which is bordered on the east by the Mississippi River flood levee, the west by the Sauget/Toxic Dump fence, on the south by the end of that fence, and on the north by the site security fence.

Climate

The site is located in the northern temperate zone which is characterized by warm summers and moderately cold winters. The average annual precipitation in the area is about 38 inches (ISWS, 1965). Due to the coarse cover material and lack of vegetation or any drainage development on S/SL, it must be assumed that at least 80% of the yearly precipitation infiltrates the landfill surface. Therefore, approximately 30 inches of precipitation infiltrate S/SL each year to recharge the Henry Formation water table aquifer.

GEOLOGY

S/SL is situated on the Mississippi River flood plain on thick valley fill deposits (100'+). The valley fill is comprised of two formations, one which is a thin mantle called the Cahokia Alluvium. Derived from the erosion of till and loess, the alluvium consists of unconsolidated, poorly sorted, silt, with some local sand and clay lenses. It appears to have accumulated in valleys during flood intervals after the Wisconsinan glaciers had retreated.

The Cahokia Alluvium formation unconformably overlies the Mackinaw Member of the Henry Formation. The Henry Formation is Wisconsinan glacial outwash in the form of valley train deposits. It accounts for the majority of the valley fill and is composed of sand and gravel that coarsens with depth. Due to the thickness and water capacity of this formation, it is a major aquifer for the East St. Louis area.

Mississippi limestone underlies the valley fill deposits at a depth of approximately 120 feet (Bergstrom, 1956).

Site Geology

All of the 18 borings (Appendix I) through S/SL encountered and sampled the Cahokia Alluvium formation and none encountered any of the Henry formation sands. Locations of the 18 borings appear on TECHNOS Figure 1. Permeability values for the Cahokia Alluvium from a study on nearby Dead Creek (St. John, 1981) are on the order of approximately 7×10^{-6} cm/sec.

The surface grade of the landfill is relatively flat. The Henry Formation water table aquifer was encountered in boring 16 at a depth of 22 feet. Groundwater was also encountered in boring 1 at 17 feet but probably was perched on top of a clayey lens in the Cahokia Alluvium.

Landfill Specifics

In general, S/SL is relatively flat and has approximately a four foot cover of coarse fly ash over its entirety. The refuse thickness gradually increases from three feet in the north portion to eighteen feet in the south. Observations during drilling indicate that only in one location (B16) was the water table high enough to be encountered while drilling.

CHEMICAL ANALYSES OF SOILS

The 35 soil samples collected below S/SL were tested for 112 organic priority pollutants designated by the United States Environmental Protection Agency (U.S. EPA), a special analysis for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), and selected non-priority pollutant hazardous substances. A list of compounds tested for and their detection limits appears in Table 1. Laboratory analyses of the 35 soil samples collected below S/SL appear in Table 2.

A survey of the soil analyses show high concentrations (over 1,000 ppb or 1.0 ppm) of organic contaminants including highs of 480 ppm of 2,4,6-trichlorophenol (B8A), 360 ppm of 2-chlorophenol (B4B), 3,100 ppm of 2,4-dichlorophenol (B1B), 72.0 ppm of 2,4-dimethylphenol (B4B), 100 ppm of pentachlorophenol (B4B), 250 ppm of phenol (B5B), 1.4 ppm of 2-methylphenol (B6A), 330 ppm of 4-methylphenol (B4B), 2.8 ppm of acenaphthene (B2B), 13,000 ppm of 1,2,4-trichlorobenzene (B14A), 620 ppm of 1,2-dichlorobenzene (B14A), 1,200 ppm of 1,4-dichlorobenzene (B14A), 1.2 ppm of fluoranthene (B2B), 17.0 ppm of isophorone (B11A), 380 ppm of naphthalene (B8A), 56.0 ppm of nitrobenzene (B4B), 1,100 ppm of bis(2-ethylhexyl)phthalate (B14A), 900 ppm of di-n-butyl phthalate (B14A), 23 ppm of di-n-octyl phthalate (B11A), 1.3 ppm of benzo(b)fluoranthene (B13A), 1.3 ppm of benzo(k)-fluoranthene (B13A), 6.4 ppm of chrysene (B11A), 2.0 ppm of fluorene (B2B), 5.2 ppm of phenanthrene (B11A), 5.6 ppm of pyrene (B11A), 51.0 ppm of aniline (B17B), 9.6 ppm of 4-chloranile (B16A), 3.0 ppm of dibenzofuran (B2B), 10.0 ppm of 2-methylnaphthalene (B11A), 4.6 ppm of 3-nitroaniline (B2A), 44.0 ppm of benzene (B14A), 100 ppm of chlorobenzene (B6A), 12.0 ppm of 1,2-dichloroethane (B6A), 19.0 ppm of 1,1-dichloroethane (B14A), 5.7 ppm of 1,1,2,2,-tetrachloroethane (B14A), 11.0 ppm of 1,2,-trans-dichloroethene (B14A), 790 ppm of ethylbenzene (B14A), 5.8 ppm of methylene chloride, 12.0 ppm of tetrachloroethene (B14A), 2,400 ppm of toluene (B14A), 55.0 ppm of trichloroethene (B14A), 14.0 ppm at acetone (B9B), 250 ppm of 4-methyl-2-pentanone (B14A), 64.0 ppm of styrene (B14B), 2,300 ppm of xylene (B14A), 170 ppm of PCB-1242 (B5A), 360 ppm of PCB-1254 (B5A), 70.0 ppm of PCB-1248 (B11B), 16,000 ppm of PCB-1260 (B14B), 46.0 ppm of PCB-1016 (B7B) and 66.0 ppm of total PCB (B5B).

TABLE 1 - THE 112 PRIORITY POLLUTANTS AND THEIR LOW LEVEL DETECTION LIMITS, MEDIUM LEVEL DETECTION LIMITS FOR VOLATILES ALSO GIVEN, ALL IN PBB.

ACID COMPOUNDS

2,4,6-trichlorophenol	10
p-chloro-m-cresol	20
2-chlorophenol	10
2,4-dichlorophenol	10
2,4-dimethylphenol	10
2-nitrophenol	20
4-nitrophenol	100
2,4-dinitrophenol	50
4,6-dinitro-2-methylphenol	20
pentachlorophenol	20
phenol	10

(Non-Priority Pollutant Hazardous Substances)

benzoic acid	100
2-methylphenol	10
4-methylphenol	10
2,4,5-trichlorophenol	100

BASE-NEUTRAL COMPOUNDS

acenaphthene	10
benzidine	40
1,2,4-trichlorobenzene	10
hexachlorobenzene	10
hexachloroethane	10
bis(2-chloroethyl)ether	10
2-chloronaphthalene	10
1,2-dichlorobenzene	10
1,3-dichlorobenzene	10
1,4-dichlorobenzene	10
3,3'-dichlorobenzidine	20
2,4-dinitrotoluene	20
2,6-dinitrotoluene	20
1,2-diphenylhydrazine as azobenzene)	20
fluoranthene	10
4-chlorophenyl phenylether	10
4-bromophenyl phenyl ether	10

BASE/NEUTRAL COMPOUNDS

bis-(2-chlorolsopropyl)ether	20
bis-(2-chloroethoxy)methane	20
hexachlorobutadlene	10
hexachlorocyclopentadlene	10
isophorone	10
naphthalene	10
nitrobenzene	10
N-nitrosodiphenylamine	10
N-nitrosodi-n-propylamine	20
bis(2-ethylhexyl)phthalate	10
butyl benzyl phthalate	10
di-n-butyl phthalate	10
di-n-octyl phthalate	10
diethyl phthalate	10
dimethyl phthalate	10
benzo(a)anthracene	10
benzo(a)pyrene	20
benzo(b)fluoranthene	20
benzo(k)fluoranthene	20
chrysene	10
acenaphthylene	10
anthracene	10
benzo(ghl)perylene	20
fluorene	10
phenanthrene	10
dibenzo(a,h)anthracene	20
indeno(1,2,3-cd)pyrene	20
pyrene	10

(Non-Priority Pollutant Hazardous Substances)

aniline	10
benzyl alcohol	20
4-chloroaniline	50
dibenzofuran	10
2-methylnaphthalene	20
2-nitroaniline	100
3-nitroaniline	100
4-nitroaniline	100

VOLATILES

	low	medium
acrolein	50	100
acrylonitrile	50	100
benzene	2.5	5
carbon tetrachloride	2.5	5
chlorobenzene	2.5	5
1,2-dichloroethane	2.5	5
1,1,1-trichloroethane	2.5	5
1,1-dichloroethane	2.5	5
1,1,2-trichloroethane	2.5	5
1,1,2,2-tetrachoroethane	2.5	5
chloroethane	2.5	5
2-chloroethylvinyl ether	2.5	5
chloroform	2.5	5
1,1-dichloroethene	2.5	5
1,2-trans-dichloroethene	2.5	5
1,2-dichloropropane	2.5	5
trans-1,3-dichloropropene	2.5	5
cis,1,3-dichloropropene	5	10
ethylbenzene	2.5	5
methylene chloride	2.5	5
chloromethane	2.5	5
bromomethane	2.5	5
bromoform	2.5	5
bromodichloromethane	2.5	5
fluorotrichloromethane	2.5	5
chlorodibromomethane	2.5	5
tetrachloroethene	2.5	5
toluene	2.5	5
trichloroethene	2.5	5
vinyl chloride	2.5	5

(Non-Priority Pollutant Hazardous Substances)

acetone	50	100
2-butanone	100	200
carbondisulfide	5	10
2-hexanone	50	100
4-methyl-2-pentanone	50	100
styrene	2.5	5
vinyl acetate	5	10
o-xylene	2.5	5

PESTICIDES

aldrin	4.0
dieldrin	4.0
chlordane	4.0
4,4'-DDT	4.0
4,4'-DDE	4.0
4,4'-DDD	4.0
endosulfan I	4.0
endosulfan II	4.0
endosulfan sulfate	4.0
endrin	4.0
endrin aldehyde	4.0
heptachlor	4.0
heptachlor epoxide	4.0
BHC-Alpha	4.0
BHC-Beta	4.0
BHC-Delta	4.0
BHC-Gamma	4.0
PCB-1242	4.0
PCB-1254	4.0
PCB-1221	4.0
PCB-1232	4.0
PCB-1248	4.0
PCB-1260	4.0
PCB-1016	4.0
toxaphene	4.0

DIOXINS	ug/kg
2,3,7,8-tetrachlorodibenzo-p-dioxin	0.16

TABLE 2 - ORGANIC ANALYSES OF SOILS BELOW SAUGET/SAUGET LANDFILL, IN PPB

	BORING/SAMPLE NUMBER Depth (in feet)							
	B1A 10.0-11.5	B1B 17.5-19.0	B2A 13.5-15.5	B2B 17.0-19.0	B3A 10.0-12.0	B3B 13.5-15.5	B4A 10.0-12.0	B4B 13.5-15.5
2,3,7,8-TCDD								3.31
2,4,6-trichlorophenol	2,500	170,000	22,000	520	1400	1500		94,000
2-chlorophenol	24,000	65,000	800		1500	LT	57,000	360,000
2,4-dichlorophenol	66,000	3,100,000	31,000	1700	760	4500		370,000
2,4-dimethylphenol			500					72,000
4,6-dinitro-2-methylphenol								
pentachlorophenol		86,000	5400	LT		11,000		100,000
phenol	24,000	55,000	45,000	4400	3200	100,000	98,000	88,000
2-methylphenol								
4-methylphenol			LT		560	LT		330,000
2,4,5-trichlorophenol				LT				
acenaphthene			1200	2800				
1,2,4-trichlorobenzene				480			LT	100,000
1,2-dichlorobenzene	LT		LT			LT		20,000
1,4-dichlorobenzene			1800	720	LT	760	LT	66,000
fluoranthene				1200				LT
isophorone								
naphthalene			11,000	8300				LT
nitrobenzene		8800	400					56,000
N-nitrosodiphenylamine								
bis(2-ethylhexyl)phthalate				LT				62,000
butyl benzyl phthalate								

Blank = Not detected
LT = Present, but lower than the detection limit for low hazard analyses.
LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B1A 10.0-11.5	B1B 17.5-19.0	B2A 13.5-15.5	B2B 17.0-19.0	B3A 10.0-12.0	B3B 13.5-15.5	B4A 10.0-12.0	B4B 13.5-15.5
di-n-butyl phthalate	LT							LT
di-n-octyl phthalate								
diethyl phthalate								
benzo(a)anthracene								
benzo(a)pyrene								
benzo(b)fluoranthene								
benzo(k)fluoranthene								
chrysene				400				
anthracene								
benzo(ghi)perylene			600	2000				
fluorene			1000	2700				LT
phenanthrene								
dibenzo(a,h)anthracene								
indeno(1,2,3-cd)pyrene			LT	LT				LT
pyrene								
aniline			LT					
4-chloroaniline			1000	3000				
dibenzofuran			2000	2300				
2-methylnaphthalene			4600					
3-nitroaniline								
benzene								

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TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B1A 10.0-11.5	B1B 17.5-19.0	B2A 13.5-15.5	B2B 17.0-19.0	B3A 10.0-12.0	B3B 13.5-15.5	B4A 10.0-12.0	B4B 13.5-15.5
chlorobenzene							10,000	40,000
1,2-dichloroethane								
1,1-dichloroethane								
1,1,2,2-tetrachloroethane								
1,2-trans-dichloroethene								
ethylbenzene								
methylene chloride			7.4	3.7	LM	8.0		
tetrachloroethene								
toluene								
trichloroethene								
acetone			960			977		LM
2-butanone								
4-methyl-2-pentanone						LT		
styrene								
o-xylene								5100
PCB-1242				2.0				
PCB-1254								
PCB-1248	1000							
PCB-1260			485.2		69.6			
PCB-1016			2120.6					
Total PCB							68,000	1,000,000

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TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B5A 13.5-15.5	B5B 17.0-19.0	B6A 10.0-12.0	B6B 13.5-15.5	B7A 10.0-12.0	B7B 13.5-15.5	B8A 13.5-15.5	B8B 17.5-19.5
2,3,7,8-TCDD								0.11
2,4,6-trichlorophenol	130,000	26,000	2700	4800	2700		480,000	10,000
2-chlorophenol	31,000	8400	1600	1600	LT			
2,4-dichlorophenol	560,000	260,000	17,000	15,000	6100		1,500,000	64,000
2,4-dimethylphenol			2000					
4,6-dinitro-2-methylphenol								
pentachlorophenol				16,000	25,000	31,000		
phenol	140,000	250,000	45,000	11,000	1800			
2-methylphenol			1400	600				
4-methylphenol		36,000	7000	1400				
2,4,5-trichlorophenol								
acenaphthene								
1,2,4-trichlorobenzene	86,000	13,000					120,000	
1,2-dichlorobenzene	100,000	28,000	LT				180,000	
1,4-dichlorobenzene			3100	800				
fluoranthene								
isophorone								
naphthalene		LT	800	LT			380,000	LT
nitrobenzene	27,000	11,000	LT				52,000	
N-nitrosodiphenylamine								
bis(2-ethylhexyl)phthalate								
butyl benzyl phthalate								

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TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B5A 13.5-15.5	B5B 17.5-19.0	B6A 10.0-12.5	B6B 13.5-15.5	B7A 10.0-12.0	B7B 13.5-15.5	B8A 13.5-15.5	B8B 17.5-19.5
di-n-butyl phthalate			400	LT				
di-n-octyl phthalate								
diethyl phthalate								
benzo(a)anthracene								
benzo(a)pyrene						LT		
benzo(b)fluoranthene						LT		
benzo(k)fluoranthene						LT		
chrysene						LT		
anthracene								
benzo(ghi)perylene								
fluorene								
phenanthrene								
dibenzo(a,h)anthracene								
indeno(1,2,3-cd)pyrene								
pyrene								
aniline								
4-chloroaniline			9000					
dibenzofuran								
2-methylnaphthalene								
3-nitroaniline								
benzene						3.2	LM	

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TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B5A 13.5-15.5	B5B 17.0-19.0	B6A 10.0-12.0	B6B 13.5-15.5	B7A 10.0-12.0	B7B 13.5-15.5	B8A 13.5-15.5	B8B 17.5-19.5
chlorobenzene	18,000	27,000	100,000	8.4		4.2	7100	
1,2-dichloroethane			12,000	3.4				
1,1-dichloroethane								
1,1,2,2-tetrachloroethane								
1,2-trans-dichloroethene								
ethylbenzene			46,000	3.8		4.5		
methylene chloride				15.0	86.0	45.0	LT	
tetrachloroethene						LT		
toluene			50,000	LT		6.1		
trichloroethene						LT		
acetone				330	200	2600		
2-butanone								
4-methyl-2-pentanone				LT	LT	LT		
styrene								
o-xylene			140,000	13.0	LT	22.0		
PCB-1242	170,000						1700	2700
PCB-1254	360,000							
PCB-1248				4700				
PCB-1260					590	13,000	880	1500
PCB-1016					2300	46,000		
Total PCB		66,000						

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LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B9A 15.0-17.0	B9B 17.0-19.0	B10A 17.0-19.0	B10B 19.0-21.0	B11A 17.0-19.0	B11B 19.0-21.0	B12A 17.0-19.0	B12B 19.0-21.0
2,3,7,8-TCDD			P		P	P		
2,4,6-trichlorophenol	LT	600	48,000	640			4400	9400
2-chlorophenol	640	1100	1700	LT			1200	520
2,4-dichlorophenol	7400	9800	170,000	9600	3200	20,000	8800	4200
2,4-dimethylphenol		LT						
4,6-dinitro-2-methylphenol								
pentachlorophenol		4800		2200			24,000	920
phenol	7500	14,000	32,000	11,000	6200	37,000	17,000	7500
2-methylphenol								
4-methylphenol	1400	2300	2700				1000	720
2,4,5-trichlorophenol								
acenaphthene								
1,2,4-trichlorobenzene			11,000				520	3600
1,2-dichlorobenzene			11,000		LT			800
1,4-dichlorobenzene		LT	27,000		LT			1000
fluoranthene								
isophorone					17,000	LT		720
naphthalene			6500		72,000	35,000	LT	640
nitrobenzene								
N-nitrosodiphenylamine							LT	
bis(2-ethylhexyl)phthalate	440				52,000	34,000	440	
butyl benzyl phthalate					LT			

Blank = Not detected.
LT = Present, but lower than the detection limit for low hazard analyses.
LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B9A 15.0-17.0	B9B 17.0-19.0	B10A 17.0-19.0	B10B 19.0-21.0	B11A 17.0-19.0	B11B 19.0-21.0	B12A 17.0-19.0	B12B 19.0-21.0
di-n-butyl phthalate		1500	LT		23,000	LT		
di-n-octyl phthalate								
diethyl phthalate	LT	840						
benzo(a)anthracene								
benzo(a)pyrene								
benzo(b)fluoranthene								1000
benzo(k)fluoranthene								1000
chrysene					6400			
anthracene								
benzo(ghi)perylene								
fluorene								
phenanthrene					5200			
dibenzo(a,h)anthracene								
indeno(1,2,3-cd)pyrene								
pyrene					5600			
aniline								
4-chloroaniline								LT
dibenzofuran								
2-methylnaphthalene					10,000			
3-nitroaniline								
benzene			LM					

Blank = Not detected.
LT = Present, but lower than the detection limit for low hazard analyses.
LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B9A 15.0-17.0	B9B 17.0-19.0	B10A 15.0-17.0	B10B 17.0-19.0	B11A 15.0-17.0	B11B 17.0-19.0	B12A 15.0-17.0	B12B 17.0-19.0
chlorobenzene			5200		LM			
1,2-dichloroethane								
1,1-dichloroethane								
1,1,2,2-tetrachloroethane								
1,2-trans-dichloroethene								
ethylbenzene			6500		220,000			
methylene chloride	3.3	300	8700	LT			LT	
tetrachloroethene								
toluene			130,000		1,300,000	100,000		LM
trichloroethene					42,000			
acetone	210	14,000		4400				
2-butanone								
4-methyl-2-pentanone							LT	
styrene								
o-xylene			30,000		650,000	70,000		LM
PCB-1242	600		NA					
PCB-1254			NA					
PCB-1248			NA		38,000	70,000		
PCB-1260	1500	1300	NA	120	45,000	681,000	7000	5000
PCB-1016			NA	78.0			2200	3900

Blank = Not detected.
LT = Present, but lower than the detection limit for low hazard analyses.
LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B13A 17.0-19.0	B13B 19.0-21.0	B14A 17.0-19.0	B14B 19.0-21.0	B15A 22.0-24.0	B15B 24.0-26.0	B16A 22.0-24.0	B17A 22.0-24.0
2,3,7,8-TCDD			P	P				
2,4,6-trichlorophenol	20,000	4600			800	1900	7700	6400
2-chlorophenol	2500	3800			600	1600	4600	100,000
2,4-dichlorophenol	9400	11,000	460,000			11,000	27,000	120,000
2,4-dimethylphenol		LT					680	
4,6-dinitro-2-methylphenol	LT							
pentachlorophenol	12,000	44,000		16,000	4200	12,000	39,000	26,000
phenol	8900	15,000			6000	13,000	16,000	50,000
2-methylphenol								
4-methylphenol	920	1400		16,000		1000	1900	9200
2,4,5-trichlorophenol							LT	
acenaphthene								
1,2,4-trichlorobenzene	2400	3000	13,000,000	2,000,000				
1,2-dichlorobenzene			620,000	55,000			LT	
1,4-dichlorobenzene	1300	2000	1,200,000	100,000		1600	4100	
fluoranthene								
isophorone				14,000				
naphthalene		LT	210,000	20,000		720	2000	
nitrobenzene								
N-nitrosodiphenylamine		400						
bis(2-ethylhexyl)phthalate			1,100,000	220,000				4600
butyl benzyl phthalate				LT		LT		

Blank = Not detected.
LT = Present, but lower than the detection limit for low hazard analyses.
LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B13A 17.0-19.0	B13B 19.0-21.0	B14A 17.0-19.0	B14B 19.0-21.0	B15A 22.0-24.0	B15B 24.0-26.0	B16A 22.0-24.0	B17B 22.0-24.0
di-n-butyl phthalate		LT	900,000	49,000	LT	3800		
di-n-octyl phthalate		LT						
diethyl phthalate						LT		
benzo(a)anthracene								
benzo(a)pyrene	LT							
benzo(b)fluoranthene	1300*							
benzo(k)fluoranthene	1300*							
chrysene								
anthracene								
benzo(ghi)perylene	880							
fluorene								
phenanthrene								
dibenzo(a,h)anthracene	LT							
indeno(1,2,3-cd)pyrene	LT							
pyrene								
aniline							680	
4-chloroaniline	LT	2200					9600	
dibenzofuran								
2-methylnaphthalene				LT				
3-nitroaniline								
benzene			44,000					

Blank = Not detected.
LT = Present, but lower than the detection limit for low hazard analyses.
LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)							
	B13A 17.0-19.0	B13B 19.0-21.0	B14A 17.0-19.0	B14B 19.0-21.0	B15A 22.0-24.0	B15B 24.0-26.0	B16A 22.0-24.0	1317A 22.0-24.0
chlorobenzene			63,000	LM				
1,2-dichloroethane								
1,1-dichloroethane			19,000					
1,1,2,2-tetrachloroethane			5700					
1,2-trans-dichloroethene			11,000					
ethylbenzene			790,000	330,000		LT		
methylene chloride	50.0	13.0	5800		2.5	23.0		LM
tetrachloroethene			12,000					
toluene			2,400,000	540,000				
trichloroethene			55,000					
acetone	90.0	430			540	1400		
2-butanone			LM					
4-methyl-2-pentanone		LT	250,000		LT			
styrene				64,000	4.2	5.3		
o-xylene			2,300,000	1,400,000		LT		
PCB-1242						5000		
PCB-1254								
PCB-1248								
PCB-1260	770	1300	2,900,000	16,000,000	190	1000	370	68.0
PCB-1016					210			
Total PCB								

Blank = Not detected.
LT = Present, but lower than the detection limit for low hazard analyses.
LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)						
	B17B 24.0-26.0	B18A 22.0-24.0	B18B 24.0-26.0	Blank 1	Blank 2	Spike @1.0 ppb	Spike @1.0 ppb
2,3,7,8-TCDD						0.37	0.91
2,4,6-trichlorophenol 2-chlorophenol 2,4-dichlorophenol 2,4-dimethylphenol 4,6-dinitro-2-methylphenol pentachlorophenol phenol	3800						
2-methylphenol 4-methylphenol 2,4,5-trichlorophenol acenaphthene 1,2,4-trichlorobenzene 1,2-dichlorobenzene 1,4-dichlorobenzene	550		LT				
fluoranthene					1000		
isophorone naphthalene nitrobenzene N-nitrosodiphenylamine bis(2-ethylhexyl)phthalate butyl benzyl phthalate	580	910	1400	LT			

Blank = Not detected.
LT = Present, but lower than the detection limit for low hazard analyses.
LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)				
	B17B 24.0-26.0	B18A 22.0-24.0	B18B 24.0-26.0	Blank 1	Blank 2
di-n-butyl phthalate			LT		
di-n-octyl phthalate		LT			
diethyl phthalate					
benzo(a)anthracene		520			600
benzo(a)pyrene					LT
benzo(b)fluoranthene		LT			LT
benzo(k)fluoranthene		LT			LT
chrysene		640			560
anthracene					
benzo(ghi)perylene					
fluorene					
phenanthrene					720
dibenzo(a,h)anthracene					
indeno(1,2,3-cd)pyrene					
pyrene		LT			800
aniline	51,000	1700			
4-chloroaniline		960			
dibenzofuran					
2-methylnaphthalene					
3-nitroaniline					
benzene					

Blank = Not detected.
LT = Present, but lower than the detection limit for low hazard analyses.
LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

TABLE 2 (Continued)

	BORING/SAMPLE NUMBER Depth (in feet)				
	B17B 24.0-26.0	B18A 22.0-24.0	B18B 24.0-26.0	Blank 1	Blank 2
chlorobenzene	4.1				
1,2-dichloroethane					
1,1-dichloroethane					
1,1,2,2-tetrachloroethane					
1,2-trans-dichloroethene					
ethylbenzene	7.7				
methylene chloride	6.1	19.0	47.0	LM	6.9
tetrachloroethene					
toluene					
trichloroethene					
acetone	2000		260		
2-butanone					
4-methyl-2-pentanone					
styrene					
o-xylene	23.0				
PCB-1242					
PCB-1254					
PCB-1248					
PCB-1260	160		2400		260
PCB-1016					
Total PCB		670			

Blank = Not detected.
LT = Present, but lower than the detection limit for low hazard analyses.
LM = Present, but lower than the detection limit for medium hazard analyses.
P = The sample could not be cleaned up sufficiently to yield TCDD results.
NA = Not analyzed, sample could not be cleaned up sufficiently.

Samples which contained the highest concentrations of a particular contaminant include B14A (fifteen), B11A (six), and B4B (five). Sample B4B also contain the highest (3.31 ppb) concentration of TCDD.

A review of sample blanks shows blank 2 with contamination detected. Since this blank was collected in a parking lot where tar and petroleum contaminants were present, this data does not affect the data set. TCDD spikes showed reasonable results.

DISCUSSION

Of the 112 organic compounds analyzed from the U.S. EPA priority pollutant list, 63 have been confirmed to exist in the soil under S/SL. Samples with high concentrations of halogenated organic chemicals, such as chlorophenol and chlorobenzenes, found with high concentrations of polychlorinated biphenyls are particularly interesting. Studies have shown that uncontrolled burning (which was the subject of many site inspection reports during operation) of these substances leads to the formation of polychlorinated dibenzo-p-dioxin and similar polychlorinated dibenzofuran classes. Therefore, it is not surprising that two samples, B4B and B8B, did contain low concentrations of TCDD. It is also quite likely that samples B14A and B14B, which contained high concentrations of halogenated compounds, would have also yielded measurable TCDD results, but the samples could not be cleaned up enough in the laboratory to yield results.

Though TCDD was quantified in two samples close to the Sauget/ Toxic Landfill, contamination by organic compounds is generally spread evenly throughout the soils under the landfill. Both times TCDD was found in soils, it was the lower of two samples taken. This is most likely due to a physical washing of the compound downward by percolation of precipitation infiltration. Infiltration of precipitation through the cover of the landfill is on the order of 8,400,000 gallons/year (this is assuming an area of contamination of 450,000 sq./ft. and approximately 30 inches of precipitation infiltrating a year). This means that 8,400,000 gallons of undetermined quality leachate is formed each year and recharges the Henry Formation aquifer. Due to their densities upon reaching the aquifer, organic compounds could be expected to descend and possibly contaminating lower bedrock aquifers.

RE ERENCES

Bergstrom, R. E., and T. F. Walker 1956. Groundwater Geology of the East St. Louis Area, I linois, ISGS, Report of Investigation - 191, P. 44.

St. John, R. B., A. Preli inary Hydrogeologic Investigation in the Northern Portion of De id Creek and Vicinity. IEPA, p. 102.

Shelton, 1982. Aerial Phc ographic Analyses of Hazardous Waste Disposal Sites in Illinois United States Environmental Protection Agency, p. 49.

APPENDIX I-BORING LOGS

DRILLING LOG

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-1

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/13/83

Completion Date 7/13/83

Ground El. [redacted]

Grid Location 250W/50'

Total Depth of Boring 19.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1					
	2					
	3					
	4	Cinder Fill, blank w/wood chips				
	5					
	6					
	7	Refuse				
	8					
	9					
		Cahokia Alluvium				

11/13/81

State Illinois

Boring No. B-1, 250W/50

Site Sauget/Sauget Landfill

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11	Cahokia Alluvium, gray, fine to medium grained sand, micaceous		B1A		
	12					
	13					
	14					
	15					
	16					
	17			BIB	H_2O @ 17.0'	
	18	Cahokia Alluvium, very fine grained sand				
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

11/13/81

DRILLING LOG

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-2

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/13/83

Completion Date 7/13/83

Ground El.

Grid Location 85W/50

Total Depth of Boring 19.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1					
	2	Cinder Fill, black				
	3					
	4					
	5	Refuse				
	6					
	7					
	8					
	9					

State Illinois

Boring No. B2, 85W/50

Site Sauget/Sauget Landfill

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11	Refuse				
	12					
	13					
	14	Cahokia Alluvium, fine grained sand, micaceous				
	15			B2A		
	16					
	17					
	18	Cahokia Alluvium, fine grained sand, micaceous				
	19			B2B		
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-3, 140W/250

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11	Cahokia Alluvium, black, clayey silt		B3A		
	12					
	13					
	14	Cahokia Alluvium, gray, silt				
	15			B3B		
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-4

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/13/83

Completion Date 7/13/83

Ground El.

Grid Location 260W/250

Total Depth of Boring 15.5'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1					
	2	Cinder Fill, blank				
	3					
	4					
	5	Refuse				
	6					
	7					
	8					
	9					

11/13/81

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-4, 260W/250

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11	Cahokia Alluvium, gray, clayey silt, micaceous		B4A		
	12					
	13					
	14					
	15	Cahokia Alluvium, gray, fine grained sand, micaceous		B4B		
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-5

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/14/83

Completion Date 7/14/83

Ground El.

Grid Location 250W/475

Total Depth of Boring 19.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1	Cinder Fill, black				
	2					
	3					
	4					
	5	Refuse				
	6					
	7					
	8					
	9					

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State Illinois

Boring No. B-5, 250W/475

Site Sauget/Sauget Landfill

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11	Refuse, wood chip and debris				
	12					
	13					
	14					
	15	Cahokia Alluvium, light brown, silty, sand		B5A		
	16					
	17					
	18	Cahokia Alluvium, brown to black, silty, very fine grained sand		B5B	oily appearance	
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

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State Illinois

Site Sauget/Sauget landfill

Boring No. B-6

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/14/83

Completion Date 7/14/83

Ground El.

Grid Location 10W/600

Total Depth of Boring 15.5'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1	Cinder Fill, black				
	2					
	3					
	4					
	5	Refuse				
	6					
	7					
	8					
	9					

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State Illinois

Boring No. B-6, 10W/600

Site Sauget/Sauget Landfill

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11	Refuse				
	12	Cahokia Alluvium, brown, clayey, silty, fine grained sand		B6A		
	13					
	14					
	15	Cahokia Alluvium, dark brown, very fine grained sand		B6B		
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-7

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/14/83

Completion Date 7/14/83

Ground El.

Grid Location 103W/666

Total Depth of Boring 15.5'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1	Cinder Fill, black				
	2					
	3					
	4					
	5	Refuse				
	6					
	7					
	8					
	9					

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-7, 103W/666

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11	Cahokia Alluvium, brown to green sandy, silty, clay		B7A		
	12					
	13					
	14	Cahokia Alluvium, black, silty, very fine grained sand				
	15			B7B		
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-8

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/14/83

Completion Date 7/14/83

Ground El.

Grid Location 205W/795'

Total Depth of Boring 19.5'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1	Cinder Fill, black				
	2					
	3					
	4					
	5	Refuse				
	6					
	7					
	8					
	9					

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State Illinois | Boring No. B-8, 205W/795

Site Sauget/Sauget Landfill | Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11	Refuse				
	12					
	13					
	14	Cahokia Alluvium, gray, silty, very fine grained sand				
	15			B8A		
	16					
	17					
	18	Cahokia Alluvium, green, silty, very fine grained sand, w/trace clay		B8B		
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-9

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/15/83

Completion Date 7/15/83

Ground El.

Grid Location 150W/950

Total Depth of Boring 19.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1	Cinder Fill, black				
	2					
	3					
	4					
	5	Refuse				
	6					
	7					
	8					
	9					

11/13/81

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-9, 150W/950

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Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11	Refuse, cinder, wood chips				
	12					
	13					
	14	Refuse				
	15	Cahokia Alluvium, black to gray, silty, very fine to fine grained sand		B9A		
	16					
	17					
	18	Cahokia Alluvium, green, silty, very fine grained sand, w/trace clay		B9B		
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

11/13/81

DRILLING LOG

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-10

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/15/83

Completion Date 7/15/83

Ground El.

Grid Location 35W/940

Total Depth of Boring 21.5'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1	Cinder Fill, black				
	2					
	3					
	4	- - - - - - - - - - - - - - - -				
	5	Refuse				
	6					
	7					
	8					
	9					

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-10, 35W/940

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14					
	15			B10A		
		Refuse, cinders				
	16					
	17					
	18	Cahokia Alluvium, gray, fine grained sand		B10B		
	19					
	20	Cahokia Alluvium, gray, fine grained sand				
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-11

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/18/83

Completion Date 7/18/83

Ground El.

Grid Location 35W/1150

Total Depth of Boring 21.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1	Cinder Fill, black				
	2					
	3					
	4	- - - - - - - - - - - - - - - -				
	5	Refuse				
	6					
	7					
	8					
	9					

11/13/81

State Illinois

Boring No. B-11, 35W/1150

Site Sauget/Sauget Landfill

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14	Refuse				
	15					
	16					
	17					
	18	Refuse		B11A		
	19	Cahokia Alluvium, brownish red silty, clay w/trace gravel				
	20	Cahokia Alluvium, brown, silty, clayey, very fine grained sand		B11B		
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-12

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/18/83

Completion Date 7/18/83

Ground El.

Grid Location 245W/1150

Total Depth of Boring 21.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1	Cinder Fill, black				
	2					
	3					
	4					
	5	Refuse				
	6					
	7					
	8					
	9					

11/13/81

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-12

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12	Refuse				
	13					
	14					
	15					
	16					
	17					
	18	Cahokia Alluvium, gray, silty, very fine grained sand		B12A		
	19					
	20	Cahokia Alluvium, brown, silty, clayey, very fine grained sand		B12B		
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

11/13/81

DRILLING LOG

State Illinois

Site Sauget/Sauget landfill

Boring No. B-13

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/19/83

Completion Date 7/19/83

Ground El.

Grid Location 140W/1350

Total Depth of Boring 21.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1					
	2	Cinder Fill, black				
	3					
	4					
	5	Refuse				
	6					
	7					
	8					
	9					

11/13/81

State Illinois

Boring No. B-13, 140W/1350

Site Sauget/Sauget Landfill

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13	Refuse				
	14					
	15					
	16					
	17					
	18	Cahokia Alluvium, gray, very fine grained sand		B13A		
	19					
	20	Cahokia Alluvium, gray, very fine grained sand		B13B		
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

State Illinois

Site Sauget/Sauget landfill

Boring No. B-14

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/19/83

Completion Date 7/19/83

Ground El.

Grid Location 20W/1350

Total Depth of Boring 21.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1					
	2	Cinder Fill, black				
	3					
	4					
	5					
	6	Refuse				
	7					
	8					
	9					

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-14, 20W/1350

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13	Refuse				
	14					
	15					
	16					
	17					
	18	Muck, black		B14A	May have punctured and sampled the contents of a pail.	
	19					
	20	Cahokia Alluvium, black, mucky, very fine grained sand		B14B		
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-15

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/19/83

Completion Date 7/19/83

Ground El.

Grid Location 20W/1500

Total Depth of Boring 26.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1					
	2	Cinder Fill, black				
	3					
	4					
	5	Refuse				
	6					
	7					
	8					
	9					

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-15, 20W/1500

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18	Refuse				
	19					
	20					
	21	Refuse				
	22					
	23	Cahokia Alluvium, black to gray, fine grained sand		B15A		
	24					
	25	Cahokia Alluvium, black to gray, fine grained sand		B15B		
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-16

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/19/83

Completion Date 7/19/83

Ground El.

Grid Location 120W/1500

Total Depth of Boring 24.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1					
	2	Cinder Fill, black				
	3					
	4					
	5					
	6	Refuse				
	7					
	8					
	9					

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State Illinois

Site Sauget/Sauget Landfill

Boring No. B-16, 120W/1500

Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18	Refuse				
	19					
	20					
	21					
	22				H_2O @ 22.0'	
	23	Cahokia Alluvium, black to gray, silty, clayey, very fine grained sand		B16A		
	24					
	25				No further sampling was performed since it would have been below the H_2O table	
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-17

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/20/83

Completion Date 7/20/83

Ground El.

Grid Location 140W/1750

Total Depth of Boring 26.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1					
	2	Cinder Fill, black				
	3					
	4					
	5					
	6	Refuse			Oil was encountered from 6.0' to 13.0'.	
	7					
	8					
	9					

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State Illinois | Boring No. B-17, 140W/1750

Site Sauget/Sauget Landfill | Page 2 of 2

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14					
	15					
	16					
	17					
		Refuse				
	18					
	19					
	20					
	21					
	22					
	23	Cahokia Alluvium, black to gray, silty, clayey, fine grained sand		B17A		
	24					
	25	Cahokia Alluvium, black to gray, silty, clayey, very fine grained sand		B17B		
	26					
	27					
	28					
	29					
	30					

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DRILLING LOG

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-18

Drilling Firm Canonie Construction

Type of Drill CME 75

Driller Herchle Boyd

Geologist Ron St. John

Start Date 7/20/83

Completion Date 7/20/83

Ground El.

Grid Location 35W/1760'

Total Depth of Boring 26.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Ground Surface				
	1					
	2	Cinder Fill, black				
	3					
	4					
	5					
	6	Refuse				
	7					
	8					
	9					

11/13/81

State Illinois

Site Sauget/Sauget Landfill

Boring No. B-18, 35W/1760

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Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18	Refuse				
	19					
	20					
	21					
	22					
	23	Cahokia Alluvium, gray, very fine to fine grained sand		B18A		
	24					
	25	Cahokia Alluvium, gray, very fine to fine grained sand		B18B		
	26					
	27					
	28					
	29					
	30					

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APPENDIX II - MAGNETOMETERS

APPENDIX

MAGNETOMETERS

Magnetic field measurements can be used to locate buried ferromagnetic objects such as steel containers or drums, scrap iron and tools. This method is based on the fact that an induced magnetism is produced in any magnetic material within the earth's magnetic field and, if sufficiently large, can be detected as an anomaly in the ambient field. Search magnetometers respond to changes in the earth's magnetic field caused by ferrous metals. Non-ferrous metals do not produce a magnetic response.

The primary factors which influence the response of a magnetometer system are the mass of an iron or steel object and its distance from the sensor. The following list points out the variables which influence the size of a magnetic anomaly:

1) Target mass
2) Target to sensor distance
3) Target material and degree of degradation
4) Target geometry (primarily length to diameter ratio)
5) Target orientation
6) Amount and orientation of permanent magnetism in the target.

Technos utilizes a variety of magnetometers to accomplish various survey objectives. Both total field and gradiometer search magnetometers are available. Proton and cesium systems are used for total field work; fluxgate and cesium gradiometer systems are used for detailed search work. The system

commonly used by Technos for most search work is a fluxgate gradiometer built by Technos. This system permits continuous coverage along a line, as opposed to periodic sampling or station measurements obtained with other types of magnetometers. The gradiometer system also permits operation in areas in which a total field instrument will fail to function because of nearby metal fences, pipes and cables. This capability of the gradiometer system is possible since the sensor head used minimizes the presence of horizontal targets such as a steel fence while maintaining full vertical sensitivity for discrete targets below. This system can be carried by hand or can be mounted to a vehicle for covering larger areas.

The basic sensor sensitivity of the Technos gradiometer is one gamma with a system response of .58 gammas per foot over a two-foot vertical gradient. The response of the gradiometer generally falls off as one over the distance to the fourth power for discrete targets.

A secondary (less sensitive) magnetometer is used as a reconnaissance tool to sort out shallow and deeper targets when the instrument is used in combination with a metal detector and other magnetometers. This unit also is a fluxgate gradiometer and is manufactured by the Schonstedt Instrument Company. Its sensitivity is approximately an order of magnitude less than the Technos magnotometer with a gradient of approximately twenty inches, yielding an overall best system sensitivity of ten gammas per foot.